

Pest Problems of Cashew

By

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INTRODUCTION

The crisis that our country is now facing in the supply of raw cashewnuts to cater to the needs of the cashew processing units had been a topic of serious discussions in different fora at various levels. The Indian Council of Agricultural Research, in 1976, set up an Expert Committee under the chairmanship of Prof. K. N. Raj to assess the production potential of cashew plantations in India and to suggest suitable ways and means for enhancing cashew production. The Committee in its Report suggested various long-term and short-term strategies for increasing production and productivity of cashew plantations, and timely adoption of plant protection measures in the existing plantations was one of the important short-term programmes recommended for immediate implementation.

As in any other plantation crop infestation by insect pests is a major factor that limits production of cashew as well. More than sixty species of insects are now identified in India as cashew pests during different stages of its growth and development. However, when the extent of damage done by them and the economic losses they cause to the cashew crop are taken into consideration the stem and root borers, tea mosquito, leaf miner and the leaf and blossom webber are to be ranked as the major pests of cashew. Besides, there are a few species of insects, considered to be rather less serious pests now, such as the flower thrips, apple and nut borers and the nut crinkler, whose infestation results in immature fruit-drop in cashew. Among the other pests three species of foliage thrips, leaf beetles and weevils, defoliating caterpillars, shoot tip caterpillars etc. sometimes cause severe damage to cashew in certain localised tracts, particularly when they appear in sporadic proportions.

Brief descriptions of different pests, their nature and extent of damage, life histories and possible control measures are proposed to be discussed in these columns.

1.1 Stem and root borers

The longicorn beetle *Plocaederus ferrugineus* L. (Coleoptera: Cerambycidae) is the hidden enemy of cashew tree which is capable of killing the tree outright. Presence of isolated dead trees with completely dried up twigs or trees with yellow leaves or partially shed leaves and partially dried twigs is a common sight in many of the extensive cashew plantations in almost all the cashew growing tracts of our country. Infestations ranging from 1.6-4.0% have been observed in a few cashew plantations in Kerala, Karnataka, Tamil Nadu and Maharashtra during a casual survey; however, in certain neglected plantations where the trees killed by stem borer infestation were left as such, higher intensities of upto 10% were observed.

The major symptoms of stem borer infestation include the presence of small holes in the collar or trunk region of the tree, oozing out of the resinous gummy substance, extrusion of chewed up fibres, scrapes of bark tissues and castings commonly known as 'frass' through the holes, yellowing and shedding of leaves, drying of twigs and final death of the tree. Depending on the stage and intensity of attack the infested tree will manifest these symptoms somewhat sequentially.

The adult is a medium sized (25-40 mm) long reddish brown longicorn beetle, the head and thorax of which are dark brown or almost black in colour. The beetle lays eggs deeply inserted into the live tissues in the crevices of loose bark of the trunk or in the exposed portions of roots of cashew trees. The eggs are of ovoid shape and dirty white colour. They hatch out as tiny grubs in about 4-6 days. The grubs bore into the fresh tissues of bark and feed on the subepidermal and sapwood tissues and make tunnels in irregular directions. As a result of injury to the live cells a resinous material oozes out, which on exposure to air gets hardened as a gummy substance. The oozing out of the gummy substance is known as gummosis, which is one of the characteristic symptoms of stem borer infestation. The larval tunnels made by

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P. ferrugineus in the sap wood are broad and irregular, deepest in the middle and shallow at the sides, and fully packed with frass and fibrous tissues. When the vascular tissues are damaged the ascent of plant sap will be arrested, as a result of which the leaves become yellow and are shed subsequently. During later stages the twigs also dry up and finally the tree dies. The grub phase lasts for about 6-7 months under the West Coast conditions. The fully grown grub descends to the root zone through tunnels in the sap wood and bores through into the heart wood and forms a chamber tightly packed with fibrous tissues and frass providing protection to the calcareous cocoon within which the grub undergoes pupation. Normally the pupal period lasts for 60 days (inside the cocoons). However, in laboratory cages when cocoon was not formed the pupal period lasted for 20 days only.

Besides cashew *P. ferrugineus* also infests host plants like *Bombax malabaricum*, *Boswellia serrata*, *Buchanania latifolia*, *Diospyros melanoxylon*, *Hardwickia binata* and *Launea grandis*.

Two other allied species of longicorn beetles viz. *Plocaederus obesus* Gahan and *Batocera rufomaculata* De G. were also observed infesting cashew trees. *P. obesus* is chestnut brown in colour with black hairs. The adult beetle is 40 mm long and fully grown larva measures 75 mm. The excavations made by grubs are comparatively wider than those made by *P. ferrugineus* grubs. Adult of *Batocera rufomaculata* is dark brown with fine greyish vestiture, pronotum with two kidney-shaped orange yellow spots, white scutellum, and elytra with numerous black tubercles and yellowish spots of varying number and shape. The fully grown larva is 100 mm long. The larval excavations in early stages are quite extensive, irregular and deep, and fully packed with coarse fibres and scrapes of wood and bark tissues. The pupae of *B. rufomaculata* are bigger than those of *P. ferrugineus* and *P. obesus*.

Besides the above three species of stem and root borers the grubs of bark and sapwood borers like *Xylothrips flavipes* 111. (Bostrychidae), *Lampetis fastuosa* F. and *Belionota prasina* Thumb. (Buprestidae), *Xystrocera globosa* O1. (Cerambycinae), and *Coptops aedificator* F. (Lamiinae) also are quite often seen in association with the stem and root borer infested trees. These are only secondary pests attacking stem borer infested and drying cashew trees. However, their infestation contribute so much to aggravate the condition of stem and root borer infested trees. *Xylothrips flavipes* is a widespread species occurring on a

variety of host plants. The buprestid *Belionota prasina* is a general wood borer known also from other anacardiaceous host plants such as *Buchanania latifolia*, *Mangifera indica* and *Spondias mangifera*. Adult is a dark bluish green smooth beetle. The grub is 60 mm long. The larval tunnels of *Xystrocera globosa* run in the inner bark and sometimes even in the sapwood. *Coptops aedificator* is a dark borer of dead trees rather than a sapwood borer. The beetle is brown in colour with black speckles and grey as well as black markings on its elytra. The larval galleries and pupal chamber are seen mostly in the bark. This species also has a wide range of host plants.

Control measures:

Since these pests are tissue borers whose immature stages are found inside the tree trunk, the detection of their infestation in the early stage itself is quite essential for adoption of effective control measures against them well in time. Field trials on the curative control of stem and root borer infestation in cashew using different insecticides like BHC Carbaryl, Pyrethrins piperonyl butoxide, dimethoate, trichlorphon, fenitrothion, dichlorvos etc. (applied as injection to the affected parts of the trunk and drenching the base), phorate granules and aluminium phosphide tablets (applied to the tunnels in the stem) revealed that the success of curative treatment depended much on the stage and intensity of infestation. Eventhough most of the insecticides tested were effective in controlling the grubs, the trees in the middle and advanced stages of infestation could not be saved. If the infestation was detected in the early stage itself, even swabbing with BHC 0.1% suspension, after removal of the affected tissues with immature stages of the pest, was quite effective. Adoption of phytosanitary measures also is quite imperative in minimising stem and root borer infestation in cashew. The dead trees and those which are beyond recovery should be uprooted and removed from the plantation, lest they serve as natural reservoirs for multiplication of stem and root borers and other species of associated sap wood and bark borers infesting cashew trees. An experiment on the prophylactic control of cashew stem borer carried out by CPCRI at the Forest Department Cashew Plantation, Koila, Karnataka also confirmed that adoption of phytosanitary measures was more efficacious in reducing stem borer infestation rather than the prophylactic chemical treatment to the trunk and exposed root regions of cashew trees. Some sort of an integrated approach including phytosanitary measures also would be more feasible in tackling the stem and root borer infestation problem in cashew plantations.

1.2 Tea Mosquito

The Mirid (=Capsid) bug *Helopeltis antonii* Signoret, commonly known as "tea mosquito" is considered to be the most serious pest of cashew in view of the heavy economic losses it can cause to the crop. The adult bug is reddish brown in colour with a black head, red thorax and black and white abdomen. Presence of a knobbed process arising from the dorsal side of the thorax is a characteristic feature of tea mosquito. The adults and immature stages of this bug infest the tender shoots, leaves, floral branches, tender apples and developing nuts and suck the sap from them. The injury made by the suctorial mouth parts of the insect on tender shoots results in the exudation of the resinous gummy substance which on exposure to air gets hardened. Water soaked lesions appear at the feeding sites 10-15 minutes after feeding. These lesions become quite prominent within 3-6 hours. The watersoaked lesions turn pinkish brown in 24 hours and scabby and black in 2-3 days. The development of lesions in tissues around the point of entry of mouth parts of the bug is considered to be due to the action of some toxic principle present in its saliva, injected into the plant tissues at the time of sucking the plant sap. The adjacent lesions coalesce and finally the infested tender shoot dries up. Infestation on leaves results in **crinding, distortion and drying of leaves**. In severe cases of infestation, particularly at the time of emergence of new flushes, the tender shoots and leaves dry up and the infested plantation presents some sort of a scorched appearance. When the floral branches are effected it results in "blossom blight". The immature nuts infested by this pest develop characteristic eruptive spots and finally such nuts shrivel and fall off. Pest infestation in the early stages of fruit-setting and development of nuts results in the immature fruit-drop. It is estimated that the average damages to tender shoots to be about 25%, to inflorescences about 30% and to the immature nuts as 15%.

The tea mosquito has a wide range of host plants such as tea, guava, cacao, mahogany, Cinchona, red gum, apple, grapes, neem trees etc. Eventhough authentic estimates on the extent of crop losses caused by this pest in different cashew growing tracts of India are lacking, a casual survey revealed that the pest incidence is quite severe in most of the cashew plantations in Kerala, Karnataka, Goa and Maharashtra in the West Coast. Contrary to the earlier report that tea mosquito is not at all a serious problem to cashew in the east coast, recent survey had revealed its incidence in severe proportions in the cashew growing

tracts of Tamil Nadu, particularly Cuddalore, Vridhachalam and Pudukkottai areas.

The bug lays eggs deep inside the tissues of tender shoots of floral branches. Presence of a pair of fine thread-like chorionic processes projecting outside the tissues is an indication of occurrence of the egg inside. The eggs are more or less kidney-shaped and creamy white in colour. The eggs hatch out as tiny orange coloured ant-like nymphs in about 6-7 days. The nymphal phase comprising five instars is completed in 10 days. Thus, the total life cycle of the pest from egg to adult on an average works out at 16-17 days under the west coast conditions. Studies on the seasonal fluctuations in the population density of the pest carried out at CPCRI, Kasaragod during the period 1972-1977 revealed that the build up of pest population commences in October-November, synchronising with the emergence of new flushes in cashew after the cessation of monsoon showers. The pest population reaches its peak in January, when the trees are in full blossom. It was also observed that normally the pest population reaches its peak in the third month of commencement of the population build up. Tea mosquito population will be quite active in the field in different degrees of intensity till May, when succulent plant parts such as tender shoots, flower bunches, immature nuts and apples in various stages of development are quite abundant. The most favourable period for the rapid multiplication and population build up of the pest is December, January and February. However, during the monsoon period, June to September, tea mosquito population will be totally absent on grown up cashew trees.

The "inflorescence blight" in cashew was believed to be caused by tea mosquito infestation in association with the fungi, *Gloeosporium mangiferae* P. Henn. and *Phomopsis anacardi*. Earlier recommendation for its control was, therefore, a combination spray with insecticide and fungicide (Curan 0.1% in combination with Dimecron 0.03%). Subsequently, the relative efficacy of eleven insecticides in controlling *H. antonii* was assessed at the Cashew Research Station, Anakkayam and found that two sprays with DDT 0.02% (first as soon as the symptom of pest attack was noticed and the second 15 days thence) gave the best results followed by Sevin 0.1%, Endrin 0.03% and Dieldrin 0.05%. The systemic insecticides were not as effective as contact insecticides in controlling the pest. Later experiments carried out at CPCRI, Kasaragod, on the role of tea mosquito and fungi on

the incidence of blossom blight, under controlled conditions in the field, revealed that tea mosquito infestation alone is primarily responsible for the malady and that the fungi usually found associated with the blighted inflorescences are only secondary saprophytic colonisers. As such, sprays with suitable insecticides alone at the appropriate time would control the malady effectively and the fungicide need not therefore be incorporated in the spray fluid. Subsequent chemical control trials also revealed that endosulfan 0.05%, applied as high volume spray, or 0.1% as low volume spray, at the time of emergence of new flushes, panicles and at fruit-setting was effective in controlling tea mosquito population and reducing the resultant crop losses. Endosulfan treated plots recorded 10.7% infestation of inflorescences as against 32.5% in the untreated control. Average yield of nuts per tree in the treated plots was 2.5 Kg as against 1.3 Kg in the untreated control.

The recommendation of three rounds of spraying is based mainly on the trends in fluctuations of population density of the pest. Moreover, the third round of spraying done at the time of fruit-set would take care of not only tea mosquito infestation, but also other insects which cause immature fruit-drop in cashew. Infestation by tea mosquito, flower thrips, and fruit borers account for 12.3% fruit-drop during the mustard stage, 16.4% during the peanut stage and 1.1% in the later stages as revealed by a study carried out at CPCRI, Kasaragod. Tea mosquito infestation alone caused 0.27% fruit drop in the mustard stage, 10.93% in the peanut stage and 1.09% in the later stages. The time of spraying is quite important for obtaining the desired results in the control of a pest like tea mosquito. The spraying has to be done well in advance before the insect has inflicted injury to the crop. There is a critical period within which each round of spraying has to be completed, because its effectiveness and the consequent increase in yield solely depend on how quickly the spraying operations are completed.

An allied species of bug *Pachypeltis maesarum* Kirkaldy (Heteroptera: Miridae) has been reported to occur on cashew along with *H. antonii*. The infestation by this bug (both adults and immature stages) also has been noticed on tender shoots, young leaves and inflorescences. The affected leaves curl up and show characteristic necrotic lesions around the feeding punctures. The infested shoots and inflorescences dry up rapidly. The control measures adopted against tea mosquito would control this pest as well.

1.3 Leaf Miner

The leaf miner *Acrocercops syngramma* M. (Lepidoptera: Gracillariidae) commonly infests the post-harvest and post-monsoon flushes. Nursery seedlings and young plantations are more prone to infestation by this pest. The injury caused by caterpillars which mine through tender leaves becomes visible as irregular tortuous markings first. Later on the thin epidermal peel of the mined areas swells up as blistered patches. When the infested tender leaf matures the damaged portions will manifest big holes. As many as eight caterpillars were observed on a single leaf. The adult is a silvery grey moth which lays eggs in tender leaves. Freshly hatched caterpillars are pale white in colour while the fully grown ones are reddish brown. The caterpillars make their way out of the mined areas and fall to the ground. Pupation takes place in the soil.

Spraying phosphamidon or fenitrothion 0.05% at the time of emergence of new flushes is effective in controlling the pest. In areas where tea mosquito is a problem, the first round of spray done against it at the time of emergence of new flushes in October-November would take care of leaf miner infestation as well.

1.4 Leaf and blossom Webber

Of the two species of leaf and blossom webbing caterpillars, *Lamida* (= *Macalla*) *moncusalis* Walker and *Orthaga exvinacea* Hamps. recorded as cashew pests, the former has attained the status of a major pest in recent years, particularly in the coastal districts of Andhra Pradesh. The pest is assuming severe proportions in some cashew plantations of Tamil Nadu and Orissa also. However, its intensity is rather very meagre in the West Coast tracts at present.

Presence of webs on the terminal portions of shoots and blossom buds and subsequent drying of webbed shoots are the important symptoms of infestation. The galleries of silken webs reinforced with scraps of plant parts and castings are indications of the presence of caterpillars in the webbed leaves. Male of *L. moncusalis* is dark fuscous and female more olive green. Studies on the comparative biology of this pest carried out at Andhra Pradesh on cashew and mango revealed that the pest prefers cashew eventhough much difference was not observed in the life span of the pest on both the host plants. Moreover, its incidence occurs mainly on cashew and not so commonly on mango. The life cycle is completed in 37 days on cashew and 41 days on mango. Chemical control trials carried out at Andhra Pradesh have revealed that carbaryl 0.15% and malathion 0.15% were the most

effective chemicals with endosulfan 0.05% and fenitrothion 0.15% being the next best while dichlorvos 0.05 being the least effective one.

2. Less Serious Pests

Among the less serious pests the important ones are shoot tip caterpillars, defoliators, leaf thrips, leaf beetles and weevils, flower thrips, apple and nut borers and the nut crinkler.

Shoot tip caterpillars:

The caterpillars of the moth *Hypatima* (= *Chelaria*) *haligramma* M. (Lepidoptera: Gelechiidae) damage the shoot tips of cashew at the time of emergence of new flushes. They are yellowish or greenish brown in colour and the fully grown caterpillars are nearly 12 mm long. Pupation takes place inside the unopened leaves or in bore holes in the apical shoot. Pupal period lasts for 7-8 days. Pupa is yellowish red. Adult is a tiny dark moth which infests mango also. The pest damages tender leaves mostly in the bud stage and occasionally 3-4 caterpillars have been observed in a single shoot tip. The emerging leaves are folded and the caterpillar remains inside and feeds on them. It occasionally bores through into tender shoot tip upto a depth of about 20-25 mm and thus the growing shoot becomes stunted and finally dries up. Damage upto 26% has been reported in severe cases of infestation. Heavy incidence of this pest had been observed in some cashew plantations in Kozhikode district, Kerala State, in 1975.

Another Gelechid caterpillar *Anarsia epotias* Meyr. also causes considerable damage to tender cashew shoots. The newly hatched caterpillar remains in the leaf axil for some time and then slowly moves into the folds of tender unopened leaves. It then starts webbing the leaf margins together by silken threads and starts feeding by scraping the tissues. As the caterpillar reaches the third or fourth instar stage it bores into the terminal shoot tip and tunnels in feeding on the internal tissues and filling the tunnels with frass. Usually it bores to a depth of 20-30 mm. Gummosis also will be seen in such shoots. The infested shoots gradually dry up. The life cycle of the pest lasts for 24-29 days. As the infestation of shoot tip caterpillars coincides with the emergence of new flushes in cashew, the first round of spraying adopted against tea mosquito would be effective in controlling these pests as well.

Defoliators and other foliage pests:

These are sporadic pests which at times cause extensive damage by defoliation of isolated cashew trees

in some localities.

Cricula trifenestrata H. (Lepidoptera: Saturniidae)

This is a hairy caterpillar whose body is beset with numerous urticating hairs and spines. The fully grown larva is stout, dark brown and about 50-60 mm long. The caterpillars pupate inside dark silken cocoons spun amongst cashew leaves, often in masses. The adult is a medium-sized reddish brown moth with three clear concentric spots on wings.

Metanastria hyrtaca Cram. (Lepidoptera: Lasiocampidae)

This also is another sporadic pest infesting isolated cashew trees and defoliating them. The moth lays eggs in clusters on the lower surface of leaves. The eggs hatch in nine days. The newly hatched caterpillar is jet black in colour with dirty white lines between the segments. The full grown caterpillar is brown with reddish lines dorsally and yellow patches ventrally. On an average it measures about 70 mm in length. There are lateral tufts of hairs on thoracic segments projecting anteriorly. All the segments bear a thin tuft of hairs on the mid-dorsal line. Short tufts of dirty hairs occur in small patches on the mesothoracic and abdominal segments. The larval period lasts for 33 days for males and 35 days for females. There are five larval instars for males and six for females. The duration of different instars also varies for males and females. The pupal period is 12 days for both the males and females. The early instar caterpillars feed gregariously on tender leaves, whereas the fully grown ones feed voraciously on mature cashew leaves as well. During day time they congregate on the tree trunk or branches and quite often escape our notice. The caterpillars quite often completely defoliate young trees.

Lymantria obfusata Walker (Lepidoptera: Lymantriidae)

This defoliator was recorded as a new pest of cashew from South India. The caterpillars feed voraciously on cashew foliage during night, but are inactive during day time. They congregate in large numbers on the ground under dry leaves or near the base of the tree in crevices of bark or on lower parts of well shaded branches. After dusk, they crawl up the trunk, reach the canopy and feed on the foliage till dawn. Normally the feeding commences from the margins of leaves. When tender foliage is not readily available the caterpillars will feed on older leaves as well. The life-cycle of the pest lasts for 45-51 days during April-May. Observations in the laboratory and field reveal that the pest completes five generations and commences a sixth one

in a year under South Indian conditions. As the reproductive potential of this moth is quite high it can cause considerable damage in cashew plantations.

Thalassodes quadraris Guen. (Lepidoptera: Geometridae)

This has been recorded as a minor pest of cashew in Guntur and Prakasam districts of Andhra Pradesh. The adult is a medium sized moth, apple green in colour with a pale oblique line running across the fore and hind wings. The moth lays eggs singly on the margins of tender leaves. The egg hatches out as a pale yellowish pink coloured semi-looper. It feeds on tender foliage confining only to the margins. Larval periods lasts for 12-20 days and pupal period 6-10 days. Pupation takes place on the leaf surface.

Bombotelia jocosatrix Guen. (Lepidoptera: Noctuidae)

This is another leaf eating caterpillar also recorded as a cashew pest from Andhra Pradesh. Early instar caterpillars feed on the leaf margins by making holes all along. However, the fully grown caterpillars gregariously feed on the entire leaf leaving only the mid-ribs. Adults is a medium sized moth with a dark brown to dark purple brown colour, lower portion of the hind wing being white. It lays eggs on the leaf margins in rows. Newly hatched caterpillars are dirty white with distinct reddish brown spots all over the body and with sparsely distributed whitish or brownish hairs. When fully grown its colour becomes pale green. Pupation takes place inside leaf folds in silken cocoons or even in the soil. Total life cycle from egg to adult is completed in 23-38 days. This species was recorded as a minor pest on mango foliage also.

Latoia (=Parasa) lepida Cram. (Lepidoptera: Eucleidae).

Occasional infestation by this pest has been observed on isolated cashew trees. The adult moth lays eggs in groups on the lower surface of leaves. The caterpillars in the early stages feed gregariously on the interveinal leaf tissues. As the caterpillars grow they disperse themselves on the entire canopy. The caterpillars are bright green in colour and beset with urticating hairs and spines. They pupate on the stem. Pupal cases are also covered with stinging hairs. Life cycle lasts for about ten weeks.

Oenospila flavifuscata W. (Lepidoptera: Geometridae).

Adult is a medium sized moth with greenish wings. Its loopers have been observed to feed on the tender foliage of cashew. The moth lays eggs singly on the leaf edges. The eggs hatch in about five days and the

newly emerged caterpillars feed along the leaf margins. The larval period lasts for about 15 days. Fully grown caterpillars are 25 mm long. On attaining full growth its colour becomes greenish. Pupation takes place inside leaf folds. The pupa is pale red in colour and is seen attached to the leaf surface by means of silken threads. Pupal stage lasts for 10 days. The total life cycle is completed in about 30 days. Although this insect affects tender foliage it is generally considered to be a minor pest of cashew.

Euproctis scintillans W. (Lepidoptera: Lymantriidae)

This leaf eating caterpillar occasionally feeds in groups also on the inflorescences. They also scrape green tissues of the shell of tender nuts. The adult is a medium sized moth with light brown forewings having transverse markings. Hindwings are light yellow with a broad yellow margin. It lays eggs covered with hairs in batches on the leaf surface or on inflorescence. Larva is dark brown with tufts of fine hairs with a broad dorsal yellow stripe. The caterpillars in early stages show gregarious habits and disperse themselves as they grow. Pupation takes place in silken cocoons in leaf folds.

The black hairy caterpillar *Estigmene lactina* C. (Arctiidae), *Diacrisia oblique* Walker (Arctidae), *Stathmopoda* Sp. nr. *praealbata* Meyr. (Stathmopodidae) are also recorded as foliage pests of cashew. Stray cases of incidence of the leaf roller *Sylepta auranti-collis* F., the eucosmid caterpillar *Argyroplote tonsonia* M., and the tassar silk moth *Antheraea paphia* B. have also been noticed infesting cashew in some plantations. However, they are to be treated only as minor pests.

Control measures adopted against tea mosquito or leaf and blossom webber would be effective in controlling many of the above pests as well. However, in case their incidence is noticed on isolated trees they can be controlled by spraying any contact insecticide. This is quite essential to arrest the spread of the pest to the adjoining trees.

Leaf Thrips:

Three species of thrips viz. *Selenothrips rubrocinctus* Giard, *Rhipiphorothrips cruentatus* Hood and *Retithrips syriacus* M. (Thysanoptera: Thripidae) have been recorded as foliage pests of cashew. Of these, the former two species quite often cause very severe damages to nursery seedlings and young plantations, particularly during summer months. These species have been recorded as pests of cacao, arecanut and a variety of other hosts plants as well. Both the adults and

immature stages of thrips are seen in colonies on the lower surface of leaves. As a result of the rasping and sucking activity of thrips the leaves of infested trees/seedlings become pale brown and slightly crinkled with the roughening of upper surface. In severe cases there will be shedding of leaves and even stunting of growth. The nymphs of *S. rubrocinctus* commonly known as 'red banded thrips' can be distinguished by their greenish yellow colour and red bands across the first and last abdominal segments. Infestation by foliage thrips in severe proportions had been noticed during the summer months of 1974 and 1975 in different cashew growing tracts of Tamil Nadu, particularly in young plantations. It is interesting to note that *S. rubrocinctus* was found to feed on leaves that were subjected to water stress and to breed on debilitated plants. Spraying 0.05% endosulfan or fenitrothion or quinalphos, so as to give a thorough coverage to the lower surface of leaves was effective in controlling thrips infestation.

Leaf beetles and weevils

***Monolepta longitarsus* Jac. (Coleoptera: Chrysomelidae).**

These red beetles appear in large numbers on the west coast during the South-West monsoon period (June-August) and cause considerable damage to the tender foliage and portions of shoots of cashew trees. Young trees are found to be more prone to the infestation by these beetles. When disturbed the beetles will fly away producing a characteristic sound by knocking against the leaves.

Other species of beetles such as *Hyperaxis albostriata* Mots., *Hoplosoma aledominalis* Jac., *Basilepta flavicorne* Jac., and *Pagria constataipennis* Jac. (Chrysomelidae), *Arodepus marginatus* Pasc. (Attelabidae) and *Oxycetonia versicolor* Fab. (Centonidae) were also observed to congregate on new shoots of cashew and feed on them.

The leaf twisting weevil *Apoderus tranquebaricus* F. (Coleoptera: Curculionidae), which is a pest on mango, was observed on cashew also at the time of emergence of new flushes. The weevil folds the leaves along the midribs, deposits its oval orange coloured eggs on leaf tips and twists the leaf into a compact roll. The grubs which hatch out from the eggs feed on the rolled up leaf tissues.

Three other species of weevils observed feeding on tender cashew foliage are *Myloccerus discolor* B., *M. viridonus* F. and *Amblyrhinus poricollis* B. Of these, *M. discolor* was observed to cause heavy damage to tender leaves of nursery seedlings young

cashew plantations particularly during the south west monsoon period. Spraying 0.1% BHC or 0.05% carbaryl or fenitrothion or quinalphos would be effective in controlling these foliage pests.

3. Flower Thrips and other inflorescence pests

***Rhynchothrips raeensis* G. (Thysanoptera: Thripidae)** is a regular and serious pest commonly occurring in almost all the cashew growing tracts. The rasping and feeding injury made by the adults and immature stages of thrips on flowers, floral stalks, tender apples as well as on green nuts results in shedding of flowers, immature fruit drop and formation of scabby, malformed apples and nuts. A study carried out at CP-CRI, Kasaragod revealed that infestation by flower thrips alone accounts for 16.39% fruit drop (1.91% in the mustard stage, 12.57% in the pea nut stage and 1.91% in later stages) in cashew. The third round of spraying recommended against tea mosquito at the time of fruit setting would control flower thrips as well. A few other species of thrips infesting cashew flowers and causing premature flower shedding have also been recorded recently.

Other insects infesting cashew inflorescences include the lymantriid caterpillar *Euproctis scintillans* W., the geometrid caterpillar *Pingasa ruginaria* Gn., the chafer beetle *Popillia complanata* Newm., the mealy bugs *Planococcus lilacinus* (Ckll.) and *Ferrisia virgata* (Ckll.) the aphid *Toxoptera odinae* Vdg., the soft scale *Coccus* sp. and Flatids *Flata* sp. and *Ketumala* sp. Most of them are pests of minor importance only at present. However, in isolated trees they may cause considerable damage. The second and third rounds of spraying adopted for the control of tea mosquito at the time of flowering and fruit-setting will be efficacious in controlling these minor pests as well.

Apple and nut borers

***Thylocoptila panrosema* M. (Lepidoptera: Pyralidae)** is a pinkish dark, actively moving caterpillar which bores into tender apples and nuts. In cases of severe incidence nearly 10% of the apples and nuts are infested. The adult is a medium sized moth with dark forewings and pale dark hind wings. *Nephopteryx* sp. (Pyralidae) is a medium sized moth. Its forewings are narrow and dirty black in colour whereas the hind wings are pale white with a smoky base. The dark pink coloured caterpillars infest cashew fruits of all stages and cause shrivelling and premature nut fall. It is reported that the damage by this pest alone amounts to 20-60% in certain cashew plantations in Banatla and Chirala taluks of Andhra Pradesh. Generally only a single caterpillar will be seen either in the

apple or nut, but there are reports of upto five caterpillars occurring in apples and three in nuts. The fully grown larvae drop to the ground and pupate in earthen cocoons. There are five larval instars which are completed in 15-33 days. The pupal period lasts for 8-10 days. Spraying carbaryl or malathion at 0.15% concentration or endosulfan 0.05% or fenitrothion 0.15% is reported to be effective in controlling apple and nut borer infestation.

Hyalospila leuconeurella Ragonot Lepidoptera: Pyralidae and *Anarsia epotias* Meyr. (Gelechiidae) (the latter already discussed as shoot tip caterpillar) are also reported as two pests of cashew apple and nuts in South India. *H. leuconeurella* lays eggs in the groove near the junction of nut and apple. Incubation period lasts for 4-5 days. The caterpillars bore through into the apple from one end to the other. Upto six caterpillars of different stages have been observed in a single apple. The larval period lasts for 12-17 days and the pupal period 9-12 days. It is reported that *A. epotias* caterpillars of earlier generations feed on tender shoots and those of later generations infest the apples and nuts. The control measures suggested also included identification of trees which bear apples and nuts during the off-season and control of pest by destroying or spraying suitable pesticides to the infested inflorescences, apples and nuts, lest these would serve as natural reservoirs for multiplication of the pest. Nut Clinkler *Paradasynus rostratus* Distant (Heteroptera: Coreidae)

Infestation by this Coreid bug on tender nuts results in shrivelling and drying of nuts. The bug thrusts into long stylets into developing tender nuts and suck sap from them. The infested nuts turn black and finally dry up. The adult bug lays eggs on leaf surface in groups of upto 52, equally spaced and arranged in regular rows of five or six. The eggs hatch out as tiny nymphs in 8-11 days. The nymphal period com-

prising five instars is completed in 21-36 days (with an average of 27 days). The third round of spraying done against tea mosquito infestation at the time of fruit-setting would control this pest also.

Conclusion

It is clear from the above discussions that different species of insect pests are capable of inflicting so much of injury to cashew which results in heavy economic losses and that it is imperative to adopt timely plant protection measures to save the crop from the ravages of pests. This is all the more important at the present juncture when our country is facing acute scarcity in the supply of raw cashewnuts for the uninterrupted working of the cashew processing units. Though chemical control of various pests with different pesticides has been successful it would be rather difficult to adopt control measures against individual pests, except perhaps in cases of epidemic outbreaks of certain pests in some isolated tracts. Otherwise, adoption of suitable plant protection schedules covering different pests infesting cashew at a particular season would be quite ideal and more economical. For example, in areas where tea mosquito infestation is a serious problem, the present recommendation of three rounds of spraying at the time of emergence of new flushes, flower bunches and at fruit setting would be adequate enough to control other pests also infesting tender foliage, shoots, flower bunches and immature nuts. Similarly, the control schedules adopted against the shoot and blossom webber, which is a rather severe pest in the east coast tracts, would be effective against other foliage and inflorescence pests and those infesting immature nuts. The endemic areas should receive special attention and the pest management practices are adopted well in time. The insects which are only less serious pests at present are likely to become more potent pests appearing in severe proportions in isolated tracts. There should be strict surveillance on such potential enemies.

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